USE OF WILDLIFE FORAGE CLEARINGS BY WHITE-TAILED DEER IN THE ARKANSAS OZARKS[1]

by

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ABSTRACT

In a densely wooded, 243-ha enclosure in the Arkansas Ozarks deer ate sizable quantities of elbon rye and Japanese honeysuckle planted on four clearings ranging in size from 0.69 to 2.31 ha. The number of deer observed, the amount of time spent feeding, and the amount of rye and honeysuckle eaten were all greatest during the fall and winter of a year when acorns were scarce. Some ladino clover, which was also planted on clearings, was eaten in the spring and summer. The frequency of deer visits did not vary with size of clearing, but small clearings tended to be more heavily grazed than large ones. Feeding activity was greatest during the hours from 1600 to 0400.

This paper tells how white-tailed deer *(Odocoileus virginianus)* used cultivated forages on four small clearings comprising about 2 percent of a densely wooded, 243-ha enclosure in the Ozark Mountains of north-central Arkansas.

The enclosure was on the Sylamore Experimental Forest, and the research was conducteed from the spring of 1970 through 1972. Production and utilization of native and cultivated forages and availability of mast were related to total deer numbers. The clearings were planted to elbon rye *(Secale cerale)* and Japanese honeysuckle *(Lonicera japonica)* to provide winter forage. Volunteer stands of Korean and Kobe lespedez *(Lespedeza stipulacea* and *striata)* together with fall-planted ladino clover *(Trifolium repens* f. *giganteum)* furnished some spring forage. Deer populations in the enclosure varied from 13 to 25 animals.

There were four native habitat types. Upland hardwoods made up 52 percent of the area, upland pine-hardwoods 41 percent, cedar glades 4 percent, and streambottom hardwoods the remaining 3 percent. Tree basal areas ranged from 22.0 to 26.9 m^2 per ha, except that glades had only about 17.1 m^2. Understory vegetation was sparse in the densely forested upland types. The lightly forested cedar glade and the moist, fertile streambottom types had more forage per ha, but their area was so small that they contributed little to the total yield. A more complete description of the study area has been published by Segelquist and Green (1968).

Investigations prior to 1970 in this and an adjoining 273-ha enclosure had established the basic productivity of the undisturbed forest, deer food habits, and the approximate carrying capacity of the range (Segelquist and Green 1968, Segelquist *et al.* 1969).

METHODS

Four clearings were made in the winter of 1967-68. Their areas were 1.52, 2.31, 0.69, and 0.89 ha. One-half or slightly less of each clearing, a total of 2.42 ha, was planted to Japanese honeysuckle in April 1968. To prevent soil erosion and provide summer forage, Korean and Kobe lespedeza were planted on the remainder of each clearing. Clearing and planting procedures have been described in detail by Segelquist *et al.* (1971).

In September 1970 and 1971, a mixture of elbon rye and ladino clover was seeded on portions of each clearing not planted to honeysuckle. Rye furnished succulent green

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forage from November through March but matured and died in spring. Ladino clover made maximum growth in spring and early summer and, together with volunteer lespedeza, made up summer crops in 1970 and 1971.

Rye and clover were fertilized with 280 kg of 10-20-10 NPK per ha each fall at the time of planting. Summer crops were not fertilized. Honeysuckle was fertilized with 125 kg of ammonium nitrate or urea per ha in the spring and again in late summer of each year. In addition, 125 kg per ha of 10-20-10 were applied to honeysuckle in the spring of 1971.

Yields of summer legumes were sampled in August 1970 and 1971 by clipping and weighing all cultivated forage from 25 randomly located 0.9455 m^2 quadrats per ha. Summer utilization by deer was determined by visual estimates.

Yields and utilization of elbon rye were sampled by clipping and weighing herbage from 25 paired, randomly located, quadrats per ha. One 0.9455 m sq quadrat of each pair was protected from grazing by a 1.22 m sq movable wire cage. Yield from protected quadrats minus yield from grazed quadrats was considered the amount eaten by deer. To determine the period of greatest forage growth and utilization for winter crops, quadrats were clipped in mid-winter and again (after cages had been relocated) in late winter.

Honeysuckle yields were measured in August 1970 and 1971 by clipping portions of 20 randomly located plants on each of the two larger clearings and 10 randomly located plants on the two smaller clearings. One-fourth of each sample plant was clipped in 1970 and one-eighth in 1971. To determine the proportion to be clipped, a V-shaped plot frame was placed over each plant with the tip of the V at the center of the plant and the open end facing northwest. A frame with an interior angle of 90° was used in 1970 and one with an angle of 45° in 1971. All new growth within this pie-shaped wedge was clipped, ovendried, and weighed. Leaves were stripped from the twigs, separated, and reqeighed to determine the leaf-to-twig ratio. Yields per ha were calculated by multiplying the average yield per plant by the number of plants.

Utilization of honeysuckle was estimated in the winter of 1970-71 by placing wire cages over 25 randomly selected plants per ha on each clearing in the fall and comparing the amounts of forage on protected and browsed plants in March. Leaf retention was also estimated on protected plants in March. In the winter of 1971-72, utilization and leaf retention were estimated by simple visual comparisons of protected and unprotected plants.

Beginning in August 1970, and at about 6-week intervals through July 1971, deer activity was observed by men in towers overlooking each of the clearings. Observations were designed to encompass an entire 24-hour period over a span of 3 days. Each observation period was 4 hours long, and consecutive periods were 4 to 8 hours apart. Night-time observations were made with the aid of spotlights. To avoid frightening the deer from the clearings, care was taken to avoid shining the light directly into their eyes.

Several deer had previously been marked with distinctive color-coded collars and small bells, and thus were identifiable. Records were obtained on the sex and age of each animal, the amount of time spent on clearings, and the total number of animals.

Fecal pellet groups were counted at approximately 3-weed intervals from September through March on transects comprising 10 percent of each clearing. All pellets were cleared from transects after each count. These data were used to estimate the time deer spent on forage clearings. Numbers of sightings and pellet group counts for different periods were adjusted to an assumed stable population of 25 head.

To relate utilization of cultivated forages to availability of native foods, yields from native plants were sampled each August, availability of native winter forage was estimated each March, and mast yields were sampled each fall. Forage utilization was estimated in August and March. In March 1971, utilization estimates were supplemented by killing 5 deer and examing stomach contents. A detailed description of native vegetation and mast sampling procedures is included in the report by Segelquist and Green (1968). Deer census drives were made annually, in late fall and again in late winter, by 55 to 100 drivers walking abreast through the enclosure. Deer were counted as they passed through the drive line.

RESULTS

Yield of Spring and Summer Vegetation

The yield of native forage averaged 106 kg per ha in August 1970 and provided about 89 percent of all vegetation available to deer. In 1971 yields averaged 110 kg per ha and contributed 88 percent of the total vegetation. Browse—the leaves and twigs of woody vegetation—comprised 78 percent of all vegetation for the 2 years. Almost all browse was from deciduous species. Shortleaf pine *(Pinus echinata)* and eastern redcedar *(Juniperus virginiana)*, the only species of evergreen browse, produced less than 0.45 kg per ha annually.

The cultivated forages, honeysuckle and legumes, contributed 11 and 12 percent of all vegetation in the enclosure in 1970 and 1971. Lespedeza and clover averaged 782 kg per ha for all forage clearings combined in August 1970 (Table 1). The 1971 yield declined to 538 kg per ha, chiefly because of competition from common ragweed *(Ambrosia artemisiifolia)*, green foxtail *(Setaria viridis)*, and crab grass *(Digitaria ischaemum)*. Japanese honeysuckle produced 268 kg per ha in 1970 and 840 kg in 1971. As honeysuckle plants had not reached maturity in 1971, these data do not indicate the full potential of this forage species.

Table 1. Quantities (kg, oven-dry) of native and cultivated vegetation available by seasons.

Vegetation type	Hectares in each type	Yeara/	Spring and Summer		Fall and winter	
			Per ha	Total	Per ha	Total
Native vegetation	237.57	1970	106 + 18b/	25,231	21c/	5,046
		1971	110 + 16	26,028	18	4,249
Annual cropsd/	3.00	1970	782 + 38b/	2,345	1,456 + 202e/	4,289
		1971	538 + 66	1,613	2,043 + 485	6,144
Japanese honeysuckle	2.42	1970	268 + 56b/	650	268 + 56b/	650
		1971	840 + 84	2,036	840 + 84	2,036

Utilization of Spring and Summer Forage

During the spring and summer of both 1970 and 1971, deer apparently subsisted mostly on native forage, but the quantity eaten appeared to average less than 1.12 kg per ha annually. This was less than 0.23 kg per day for each deer, a value so low that it appears suspect. There was no evidence of spring and summer browsing on woody twigs, and evidence of foraging on herbaceous vegetation and deciduous browse leaves (the two classes of forage that evidently constituted the bulk of the food eaten) was very hard to detect. The difficulties encountered here had previously been remarked by Dunkeson (1955).

The total amount of cultivated forage eaten during the spring and summer of 1970 and 1971 appeared to be small as indicated by late-summer utilization estimates. There was little evidence of use on honeysuckle. Very little Korean and Kobe lespedeza appeared to be eaten—in contrast to the heavy use of cultivated lespedeza recorded by Korschgen (1954) in Missouri.

a/ For fall and winter vegetation, the years are 1970-71 and 1971-72.

b/ Means + 95 percent confidence intervals.

c/ Winter browse availability was estimated by subtracting weight of diciduous browse leaves from total summer browse yields. Confidence intervals were therefore not computed.

d/ Annual spring and summer crops consist of lespedeza and clover. Annual fall and winter crops consist of elbon rye.

e/ Confidence intervals are the summation of 95-percent confidence values computed for mid- and late-winter estimates of elbon rye yields.

Ladino clover was sometimes cropped just below the point where the leaflets join the petiole, but petioles and stems were not eaten. Thus the total quantity taken seemed small. The plants grew very rapidly in early spring but matured and died in summer. Late summer estimates, therefore, may have been too low. In addition, white clovers contain at least 14 percent crude protein on a dry-weight basis (Morrison 1939), and ladino was plentiful when protein needs of lactating does and growing fawns were greatest.

Availability of Fall and Winter Foods

Mast averaged 12 kg per ha in 1970. Black and white oak acorns *(Quercus velutina* and *Q. alba)* contributed 88 percent of the yield, and flowering dogwood *(Cornus florida)* and blackgum *(Nyssa sylvatica)* made up the remainder. In 1971 mast yields averaged 195 kg per ha, of which 96 percent was oak mast.

Native vegetation averaged 21 kg per ha in March 1971 and 18 kg in 1972 (Table 1). Deciduous browse twigs constituted about 65 percent of the total for the two years. Herbage averaged about 6 kg per ha, and ferns made up 73 percent of the yield. Total green winter vegetation averaged a little less than 7 kg per ha, of which about half was considered to be preferred by deer.

Since honeysuckle is an evergreen or tardily deciduous species, fall availability was considered to be the same and summer yields. Leaves made up 50 to 66 percent of the annual growth, and in both years some green leaves were available all winter.

Production of elbon rye averaged 1,459 kg per ha in the winter of 1970-71. About 64 percent of all growth occurred from September 15 to January 13. Moisture deficit apparently restricted late winter growth. Rainfall was more than 6 inches above normal in September and October, the early part of the fall growing season for rye, but was consistently below normal from November through March. In 1971-72 elbon rye yields averaged 2,043 kg per ha, and half the growth occurred from September 15 to January 13.

Forage clearings produced 50 percent of all vegetation available to deer during the fall and winter of 1970-71 and 66 percent in 1971-72. More important than the total quantity, however, is that the clearings produced 73 percent of all green vegetation (i.e., exclusive of browse twigs) in the winter of 1970-71 and 83 percent in 1971-72.

Fall and Winter Food Habits

Browsing of deciduous twigs was more apparent during fall and winter than during spring and summer, but March utilization estimates were still extremely low. Utilization of flowering dogwood twigs, the most heavily browsed species, ranged from 1 percent in 1971 to 4 percent in 1970. Most other stecies appeared unbrowsed.

The proportion of the fall and winter diet contributed by the forage clearings varied drastically with size of the acorn crop. In 1970-71, when acorns were scarce, deer consumed 61 percent of all Japanese honeysuckle and 57 percen of the elbon rye. From October through January 14, an estimated 0.64 kg of rye and honeysuckle was eaten per animal per day. Consumption rose to 0.95-1.22 kg per day from January 15 through the end of March.

Ninety pellet groups were counted on transect lines on all clearings in the fall and winter of 1970-71—an indication of heavy use by deer. About 75 percent of all groups were recorded from January 4 through March 1, the period of lowest mast availability.

Rumen analyses of the five deer killed in March 1971 revealed that elbon rye composed 96 percent of all foods eaten. Honeysuckle leaves made up 1 percent, while dead browse leaves and mushrooms contributed about 2 and 1 percent, respectively. Honeysuckle twigs, dogwood twigs, pine needles, and acorns were present in trace amounts. At the same time rumen contents were taken from 5 deer in the adjoining enclosure, which lacked forage clearings. In these animals, forbs, eastern redcedar, dead deciduous browse leaves, and mushrooms made up 91 percent of the diet.

Acorns were extremely plentiful in the fall and winter of 1971-72, and the herd of 13 to 14 deer consumed only 17 percent of the elbon rye and 3 percent of the honeysuckle. From October to January 13, each deer ate about 0.36 to 0.41 kg of these plants per day, and from January 14 to April 1 consumption increased to 0.59-0.64 kg.

Only 6 pellet groups were counted on all forage clearings, further indication of light use during this period of mast abundance.

Behavior of Deer on Clearings

A total of 864 man-hours was spent observing deer on the four clearings. Feeding was the animals' principal activity.

Practically all feeding observed was restricted to the annual crops. Deer were sene eating honeysuckle only for two very brief periods. Since much of the total honeysuckle yield was taken during the winter of 1970-71, deer were evidently using honeysuckle when observations were not being made.

The average feeding period for deer, excluding those frightened away within the first 15 minutes, was 35 minutes (Table 2). The number sighted and the time spent feeding were highest from November through February, when rye was abundant. Activity on clearings declined in March and May as rye matured and native spring forages began to appear. It increased again in June and July when ladino clover became abailable. Deer spent the least time on clearings in August and September. Legumes were making little active growth in August and were coarse and fibrous. In September, clearings had only recently been planted.

Table 2. Average number of minutes spent by each deer on forage clearings during each 4-hour interval of the day.

Date	Time						
	0000-0400	0401-0800	0801-1200	1201-1600	1601-2000	2001-2400	Total[a/]
August	-	1	-	2	2	7	13
September	-	-	-	-	-	1	1
November	9	-	-	-	44	11	64
January	14	-	-	-	31	1	45
February	14	1	-	-	27	8	50
March	22	-	-	-	19	-	42
May	1	-	-	-	1	13	15
June	5	1	-	-	19	11	36
July	32	1	1	-	1	11	45
Average	11	1	1	1	16	7	35

a/ Because of rounding, totals may not equal sums of 4-hour intervals.

Most of the activity occurred from 1600 to 0400 hours (Table 2). As a rule, deer entered clearings shortly before dusk, fed heavily for a time, and then left. Throughout the night they would move back and forth between the clearings and the forest at irregular intervals. During the day, there was little activity on the clearings, and belled animals were seldom heard moving in the woods. These observations contrast with those of Michael (1970), who found that deer in southern Texas usually fed during the day, with peaks at sunrise and sunset.

Several times the same deer were seen and specific belled deer were heard—near more than one of the clearings during a singel 4-hour observation period. Over the course of the study several identifiable deer were seen on all four clearings. Thus, all clearings were apparently being used by all deer.

There was little difference in the number of deer sighted on each clearing, but an inverse relationship was noted between size of clearings and number of sightings per acre. In order of ascending clearing size there were 227, 126, 79, and 44 sightings per hectare of elbon rye for all observation periods. About 5 times as many deer were sighted per hectare on the smallest clearing as on the largest one.

Utilization estimates verified that activity was greatest on the smallest clearings. During the winter of 1970-71 the percentages of rye utilized for each of the clearings from the smallest to the largest averaged 86, 67, 64, and 46.

Pellet group counts during this period also indicated that use per hectare was highest on the smallest clearing, but was greater on the largest clearing than on the two intermediate ones. The total number of pellet groups counted per hectare of elbon rye were, in order of ascending clearing size: 402, 314, 183, and 331. During the winter of 1971-72, when acorns were abundant, utilization of rye did not vary with size of clearing.

DISCUSSION

Cultivated forages appeared to supply a small part of the total spring and summer diet of deer. Because of its high quality, however, the ladino clover may have contributed substantially to the nutritional needs of fawns and lactating does.

In winter, mast yields apparently controlled the amount of cultivated forage eaten.

Cultivated forages did not replace acorns, the most highly preferred of all native foods, but did replace low-quality native winter forages in deer of diet when acorns were expended. Prior evidence (Segelquist *et al.* 1969) indicated that the scarcity or low quality of low quality of native winter forages was partially responsible for two die-offs of deer in the enclosure and an important factor limiting the carrying capacity. Thus, replacement of supplementation of native winter vegetation with cultivated forages should result in increased survival of deer and higher carrying capacity.

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